PATENT SPECIFICATION

DRAWINGS ATTACHED

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Int. Cl.:—H 01 b 17/42

COMPLETE SPECIFICATION

High-tension Electric Insulators

We STEATITE & PORCELAIN PRODUCTS LIMITED, a British Company, of Imperial Chemical House, Millbank, London, S.W.1., do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

High voltage insulators of the type used for suspending overhead power line cabes or for supporting bus-bars and the like are liable to be short-circuited by arcs, especially in damp conditions such as fog. Such arcs make it necessary to interrupt the power supply and may also do considerable damage. This tendency to arcing is enhanced by surface contamination, which serves to retain a considerable quantity of water on the otherwise non-absorbent insulator surface. Furthermore, salts or acids, which are frequently present in the contaminants, dissolve in the film of absorbed water and render it conductive.

However, the film of moisture is unstable because a current flows in it due to the high voltage stress along the insulator surface. This current tends to heat the insulator surface, and any part which initially has a somewhat higher resistance than the rest is preferentially heated and hence dries more rapidly so that its resistance increases still further. In this way one or more small parts of the insulator surface may become completely dry and hence non-conducting; the current must then traverse these small areas in the form of sparks. In severe conditions these sparks may unite to form a single spark between the ends of the insulator which then develops into an arc capable of short-circuiting the insulator. Faults may occur in this way at rate of 0.5 to 1 per annum per 100 miles of line even on a line using well designed conventional insulators; such a fault rate is considered serious on a system with some thousands of miles of line where reliability of supply is important.

Arc formation due to the instability of a surface moisture film is, of course, dependent upon the surface of the insulator becoming substantially non-conductive when dry; in fact, it has been proposed to stabilise such insulators by applying a permanently conducting layer to their whole surface.

Alternatively, it has been proposed to tackle the problem by so shaping the insulator that any film of water present on its surface is made relatively stable. One such proposed method is to form the ribs or fins, which are normally provided on a high voltage insulator, in the form of a continuous spiral or helix, the profile of this helical fin being such that intermediate between its outer edge and the body of the insulator at least one protuberance is formed. One effect of such protuberances is to form one or more narrow channels extending the whole length of the helical fin from end to end of the insulator, so that any water on the surface of the insulator tends to collect into these channels and to flow slowly down them. Thus, in moist conditions, there is a high probability of a continuous thread of water forming in each channel and being replenished if necessary, giving the thread of water a natural stability. Moreover the effect of leakage current flowing in this water thread is minimised because the voltage gradient from end to end of the helical water channel is relatively small.

According to the present invention a high tension electric insulator comprises an elongate body of insulating material having an integrally formed helical rib extending along the length of the body, at least one face of said rib having one or more protuberances

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extending along its length between the peripheral edge of the rib and the body of the insulator, so as to form one or more helical channels, part of the surface of said rib being provided with an elongate layer of semiconducting material which extends between the opposite ends of the insulator body, and the ends of said layer being maintained in electrical contact with metal fittings which are provided at the ends of the insulating body.

Preferably the semi-conducting layer is in the form of at least one narrow helical band of a semi-conducting glaze lying at least partly in one of said channels.

We have found that the combination of a helical rib with one or more protuberances and a stabilising conducting layer lead to marked advantages compared with either of the two methods used singly. The degree of permanent conductivity needed to achieve extremely good stability under difficult conditions of moisture and contamination of the surface is found to be such that the permanent current at normal working voltage need only be about 0.5 mA, while with an insulator of conventional shape about twice this current is needed. Useful effects may in fact be obtained with the present invention with even lower conductivities giving currents at normal working voltage of only about 0.1 mA. Such low stabilising currents may be important for insulators to be used on high voltage direct current systems where otherwise insulators are required with longer creepage distance than would be satisfactory for the same alternating (A.C.) working voltage.

By forming the permanent conducting layer in the form of one or more narrow bands following the helical rib it is possible to obtain the required overall low conductance with a relatively high surface conductivity. This provides an additional advantage in that the production of a semi-conducting glaze is more easily controlled if it has a relatively high surface conductivity than a much lower one. The resultant conducting layer is also more robust and is subject to a relatively low voltage stress in view of its great length between the metal fittings which are at a different potential.

A difficulty experienced with semi-conducting glazes when used for stabilising an insulator is the risk of local damage where the current flows from metal fittings to the glaze. We have found that such damage is most likely to occur when the current density and voltage stress are high. By enlarging the width of the band of semi-conducting glaze where it makes contact with each metal fitting the current density is reduced in this critical area and the voltage stress, which is low in the narrow band of conducting glaze is still lower here due to the increased conductance of the wider band.

Semi-conducting glazes have a positive temperature coefficient of conductivity. When a relatively high current flows in a wide area of conducting glaze there are, in effect, various parallel paths which the current may take, these paths being widely separated and therefore not always at the same temperature. If one path, for example one side of an insulator, becomes hotter than the others its conductivity increases and more current flows in it. This raises its temperature and the effect may be cumulative and lead to overheating of a path through the conducting glaze. In other words, due to the heating effect of the current a wide band of conducting glaze with a positive temperature coefficient of conductivity has a very limited current-carrying ability. When however the current is carried in a narrow band where parallel paths are close together and therefore do not differ much in temperature the positive temperature coefficient of conductivity has not the same disadvantage in that different parts of the band sufficiently far apart to be at different temperatures are electrically in series and any differences from point to point tend to be reduced by self-heating due to current.

It is advantageous to use a semi-conducting glaze based on an oxide of titanium known as, and hereinafter referred to as, "blue titania" which has good ability to withstand electrical stresses and corrosion. Corrosion is especially liable to occur on semi-conducting glazes used on high voltage insulators in wet conditions because of the effect of nascent products of electrolysis formed at points where current flows between the conducting glaze and moisture on its surface. Blue titania semi-conducting glaze has great resistance to this form of corrosion.

The following description relates to the drawings accompanying the provisional specification, showing, by way of example only, two embodiments of the invention. In the drawings:—

Figure 1 is a part-sectional elevation of an assembled suspension insulator;

Figure 2 is an elevation of an assembled post insulator and

Figure 3 is a diagrammatic representation of the form of the bands of semi-conducting glaze incorporated in insulators of the type shown in Figure 1 or Figure 2.

Like reference numerals are used to denote like parts in the two types of insulator shown.

The insulators shown in Figure 1 or Figure 2 consist of a rod 7 of porcelain or similar insulating material on which is formed a helical rib 8, which has protuberances 9, 10 on its top and bottom surfaces.

In Figure 1 the metal fitting 5 serves to suspend the insulator from, for example, a pylon while the metal fitting 6 might support a high voltage conductor or another insulator

unit. In Figure 2 the metal fitting 6 serves to attach the insulator rigidly to a base while a live conductor such as a bus-bar could be bolted to the top fitting 5.

On the top surface of the rib a narrow band 1 of semi-conducting glaze is formed and a similar band 2 is formed on the lower surface. The actual position of these bands and whether there is one band or two or more bands is not critical and choice may be made in the design of the insulator to suit manufacturing requirements; but preferably, at least part of each band should lie in one of the channels.

At the extremities of the insulator the narrow band widens out as indicated at 3 and 4 and may in fact extend to the full circumference of the insulator body. The metal fittings 5 and 6 make contact with the semi-conducting glaze, for example by means of soft metal packing or conducting cement, in the regions 3 and 4 respectively.

Figure 3 shows diagrammatically the form of the narrow bands of semi-conducting glaze 1 and 2 between the metal fittings 5 and 6 and the wide areas of semi-conducting glaze 3 and 4. The helical band 1 is indicated by a full line and band 2 by a dotted line.

The semi-conducting glaze is based on blue titania, formed by any of the known methods. To obtain the requisite electrical contact between the glaze and the metal fittings 5, 6 it may be necessary before assembly of the insulator to sand-blast those parts of the wide areas of glaze 3, 4 which coincide with the metal fittings 5, 6 so as to remove any poorly conducting surface film.

WHAT WE CLAIM IS:—

1. A high tension electric insulator comprising an elongate body of insulating material having an integrally formed helical rib extending along the length of the body, at least one face of said rib having one or more protuberances extending along its length between the peripheral edge of the rib and the body of the insulator, so as to form one or more helical channels, part of the surface of said rib being provided with an elongate layer of semi-conducting material which extends between the opposite ends of the insulator body, and the ends of said layer being maintained in electrical contact with metal fittings which are provided at the ends of the insulator body.

2. An insulator as claimed in claim 1 in which the semi-conducting layer is in the form of at least one narrow helical band of a semi-conducting glaze lying at least partly in one of said channels.

3. An insulator as claimed in claim 2 having two narrow helical bands of a semi-conducting glaze one of said bands being located on the upper surface and the other band being located on the lower surface of the helical rib.

4. An insulator as claimed in claim 2 or 3 in which the narrow band or bands of semi-conducting glaze widen out into a circumferential band at the extremities of the body of insulating material.

5. An insulator as claimed in any preceding claims in which the semi-conducting material is a glaze based on blue titania.

6. A high-tension electric insulator substantially as hereinbefore described with reference to and as shown in the drawings accompanying the provisional specification.

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Chartered Patent Agents.

Reference has been directed in pursuance of Section 9, subsection (1) of the Patents Act, 1949, to patent No. 845498.

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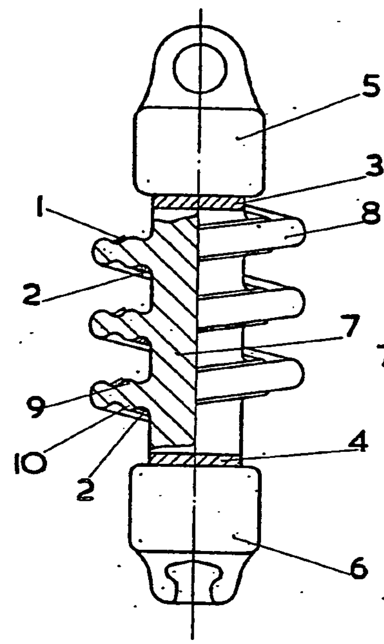

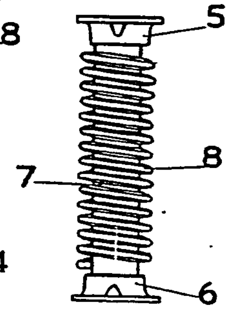

FIG. 2.

FIG. 1.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

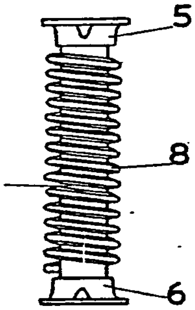

FIG. 2.

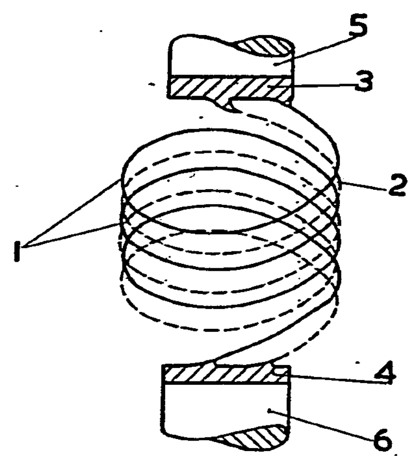

FIG. 3.

PROVISIONAL SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale

Sheets 1 & 2

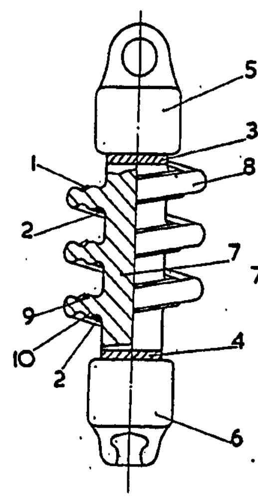

FIG. 1.

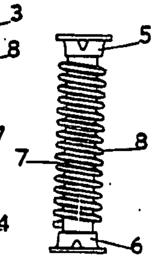

FIG. 2.

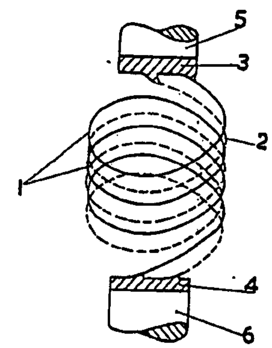

FIG. 3.